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DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
WASHINGTON

ADDRESS REPLY TO
BUREAU OF STANDARDS

Technical News Bulletin No. 44.

December 9, 1920.

GENERAL NOTE.

Owing to the current nature of the investigations mentioned in the Technical News Bulletin, sometimes it will be impossible to supply printed information regarding them. However, in these cases, when the investigation has progressed sufficiently far, the Bureau will be pleased to furnish technical data to those engaged in the particular application of the subject, in order to avoid the delay incident to publication.

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1 Length Measurements Completed During the Month

A short description of some of the Bureau's work in connection with length measurements was given in last month's bulletin. The tests made during the past month by this section consisted of the following:

10 steel tapes; 3 invar tapes; 5 invar wires; 3 cloth tapes; 100 haemacytometers; 109 extra covers for above; 15 sieves; 2 samples sieve cloth; 1 sample wire cloth; 5 glass capillaries; 1 standard metal scale for Brinell microscope.

It is evident from the above list that these tests covered a wide field both in their source and in the character of the laboratory work required. They include the testing of apparatus, a knowledge of the accuracy of which is required by the user in his trade or profession; the calibration of apparatus for use as manufacturers' standards, and the testing of instruments for precision government surveys. The five invar wires listed above were tested for the Bureau of Geodesy of Mexico. These

wires were in excellent condition, the lines being sharp, straight, and definite so that measurements of a high degree of precision could be made - from one part in 2,500,000 to one part in 4,000,000 for the 24-meter wires.

2 Recent Testing of the Ice Bar Used in the Standardization of Tapes

For the standardization of geodetic tapes, the Bureau employs a 5-meter bar which is surrounded by ice when in use, so that the measurements are always made with the bar at the temperature of 0°C. This bar has recently been retested; records of similar tests furnishing a history of the length of this bar since 1892. It is interesting to note that the bar has remained practically constant since 1906, the present determination not differing from the 1914 value by as much as the probable error of either the 1914 or 1920 values.

3 Personal Error in the Measurement of Sieves

Owing to a question raised by a sieve manufacturer as to the diameter of wire of certain sieves, an investigation of personal error and of methods of measurements of wire were made with several interesting results. The method of setting two parallel cross hairs in the micrometer microscope so that the edge of the wire is midway between them, was used in the case of these sieves, and five observers each made a series of observations with the result that personal error was quite evident. This merely confirms the more or less well-known metrological principle that it is difficult to match an equal width of bright and dark space.

4 Recent Weights and Measures Information

A table of equivalents of U. S. gallons in terms of British Imperial gallons and vice versa from 1 to 100 has been prepared for distribution. The tables also apply to other units of the same relative sizes, such as, for example, U. S. quarts to British Imperial quarts.

There has been compiled for distribution a paper on the weight per cubic foot of broken limestone and its dependence upon the specific gravity of the solid material and the percentage of voids. The voidage of various kinds of loose materials, such as sand, gravel, and stone is also given.

A lecture on dental amalgams was prepared and presented before the District of Columbia Dental Society during the month. The Bureau is interested

in these materials from the point of view of their coefficients of expansion and has conducted quite an extensive investigation of this subject at the instigation of the Surgeon General's Office of the army.

5 Recent Publications Dealing with Optical Work

A paper on the subject of "The Relations Between Quality of Color and Spectral [illegible] Distribution" was published in the September number of the Journal of the Optical Society of America. In this paper is formulated a general condition which appears to be satisfied by all spectral distributions of light which excite the same color. A second paper on "The Relation Between the Frequencies of Complementary Hues" also appeared in the same number of this journal. In this paper it is shown that the relation between the frequencies of complementary hues can be accurately represented by a rectangular hyperbola.

6 The Calibration of Lovibond Glasses Used as Working Standards in the Color Grading of Vegetable Oils

At the request of the American Oil Chemists Society, the Bureau has intercompared and calibrated in terms of its standard glasses, 16 glasses used as working standards for the color of "prime" oil. The report on this test is being published in the section of the Cotton Oil Press for December.

7 Investigation of Methods for Measuring Focal Lengths of Lenses

A determination of the accuracies of various methods for the precise measurement of focal lengths is in progress. The experimental part of this work is nearly completed and the data taken furnish definite information regarding the accuracies of the methods under investigation.

8 Completion of a New Laboratory Telescope

The design and construction of a small laboratory telescope with magnification of 3 diameters has been completed. This instrument has several optical and mechanical features not found in the telescope commonly used, such as large exit pupil at a suitable distance from the eye lens; large range of working distance, and short tube length, forming a very desirable combination. The completion of this instrument will be followed by the design of two other sizes of telescope.

9 Distribution of Standard Samples

The standard samples distributed by the Bureau are in very great demand which appears to be increasing, as samples were sent to 33 new customers [illegible] on

during the past month; 434 samples were issued on 128 orders, valued at $849.25. Samples No. 23A and 51, Bessemer 0.8% Carbon Steel and Electric Furnace 1.2% Carbon Steel, respectively, were issued for the first time during the month.

10 Rubber Jar Rings

At the request of the States Relations Service of the Department of Agriculture, a further study of rubber jar rings is to be made, with the object of aiding the educational work of that service. Specifications were prepared covering these rings some time ago and rings of good quality are being made in greater numbers all the time but it is the aim of the government to induce manufacturers to stop entirely the making of inferior rings.

11 Preparation of Specifications for Rubber Goods

The Bureau has been asked to prepare specifications for the different classes of rubber goods covered by the General Schedule of Supplies used as a basis of government purchases. A conference between the members of the General Supply Committee and the Bureau was held on November 19, in order to determine exactly what was needed. This work will be of considerable assistance in placing government purchases on a satisfactory basis of merit.

12 Recent Chemical Publications

Technologic Paper No. 177 - Sulphur and Petroleum Oils by C. E. Waters - has recently been issued. A summary of this paper is a follows:

Short accounts are given of theories concerning the origin of the sulphur and sulphur compounds which are found in crude petroleum. The forms of combination in which the element occurs, their identification and significance are briefly discussed.

Tests for the detection of sulphur are described, and the copper test is shown to be one of great delicacy. Although it will show the presence of very minute amounts of free sulphur or of hydrogen sulphide, it may be of no value when all the sulphur is in stable organic compounds.

Various methods that have been used for the determination of sulphur in oils, and finally a new procedure, are described. The new method is based on the preliminary treatment of the oil with nitric acid saturated with bromine, followed by fusion with a mixture of sodium nitrate and

carbonate. Certain sources of error which are inherent in the method and the means for their correction are taken up.

Data obtained by the analysis of certain oils by this and other methods are given. From these it appears that there is no loss of sulphur when oil is treated with nitric acid and bromine, and then ignited with sodium nitrate and carbonate. The method is recommended for laboratories which do not have a bomb calorimeter.

Inflammability of Jets of Hydrogen and Inert Gas by P. G. Ledig has appeared in the Journal of Industrial and Engineering Chemistry, Vol. 12, p. 1098, 1920. This paper is summarized as follows:

(1) Under the most favorable conditions, a jet of helium containing more than 14 per cent of hydrogen can be ignited in the air.

(2) Eighteen to twenty per cent of hydrogen may be mixed with helium, without producing a mixture which will burn with a persistent flame when issuing from an orifice under the conditions prevailing in balloon practice.

(3) More than 20 per cent of hydrogen in a hydrogen-helium mixture can not be used in a balloon without sacrificing safety from fire.

Circular 102 - Recommended Specification for Composite Thinner for Semi-paste Paints When the Use of Straight Linseed Oil is not Justified.

Circular 103 - Recommended Spacification for Spar Varnish.

Circular 104 - Recommended Specification for Asphalt Varnish.

Circular 105 - Recommended Specification for Liquid Paint.

13 Colorless Waterproofing Compounds for Building Stones

Specimens of Indiana limestone have been treated with 12 colorless waterproofing compounds. Absorption tests, exposure tests, and tests with carbonic acid have been started. The materials include a number of proprietary compounds and a few miscellaneous treatments which have been recommended.

14 Report on Hardners for Concrete Floors

A report of service tests of various concrete floor treatments has been prepared in mimeographed form and will be available for distribution in the near future. This report gives the results of actual service tests and notes the conditions of panels treated before the application of the preservative and after the lapse of periods averaging about 2 years.

15 Decarburization of Steel by Heating in Vacuo

Specimens have been heated in vacuo for periods as long as 24 hours at approximately 760°C. The carbon content of the material was reduced from 0.52% to 0.36%. Previous work described in scientific paper 356 has shown that a very appreciable surface decarburization occurred in specimens of low carbon steel after 30 minutes at 760°C. This material was iron-carbon alloy prepared at the Bureau to which no additions other than carbon had been made. The explanation suggested for the loss of the carbon in vacuo at high temperatures assumes the presence of oxygen in some form. Commercially prepared steel (metal which has been deoxidized) behaves very differently from the small melts made in the Bureau's experimental foundry without deoxidation treatment, thus substantiating the validity of the assumption made, that 30 minutes' heating in vacuo at 760°C produces no appreciable change in "commercial" steel - several hours are required to reduce the carbon content to any extent. This investigation will be continued.

16 Artificial Seasoning of Gage Steels

The investigation on the effects of various artificial seasoning treatments on the permanence of gage steels has progressed sufficiently far to permit the drawing of certain conclusions. In this work hardened gages were heated in oil at various temperatures and under varying time conditions, and also subjected to seasoning by alternate dipping in hot oil and iced brine. The results of the work are as follows:

(1) Short gages (1/8 inch) showed no appreciable changes in length, with or without various artificial seasoning treatments, over a period of approximately 7 months beginning about 1 to 2 weeks after hardening. In general the long gages (2 inch) showed no appreciable changes in planeness.

(2) For studying length changes with time, gage blocks of greater length than those used

(2 inches) would be desirable. About 6 to 8 inches is recommended.

(3) Duplicate gages show wide variations in length changes, for example, one block showed no dimensional change in 217 days between first and last measurements while a duplicate decreased (18) eighteen hundred thousandths of an inch in length in the same period.

(4) Except in the case of plain-carbon-steel containing 1.18% carbon the changes in planeness are not appreciable. In this steel relatively large variations in planeness for duplicate gages are noted.

(5) Gages produced from stainless steel and ordinary drill rod are softer than reference blocks ordinarily produced and which are kept between about 90 to 100 Shore hardness. From this standpoint, the stainless steel is unsatisfactory as it is not possible with ordinary treatment to maintain the hardness within the limits described. A higher-carbon alloy of this type would be more desirable, with possibly a decrease in chromium such as would not impair its stainless qualities and at the same time reduce production costs.

(6) The plain-carbon steel (containing 1.8 per cent carbon) appears to be the least desirable from the standpoint of permanence, showing in the main the greatest changes in length and planeness during a period approximately 7 months from first to last measurements. Probably the most desirable are steels HC and K subjected to definite seasoning treatments, the former being the steel now generally used in production of reference gages at the Bureau of Standards.

(7) Measurements at intervals of approximately one week, one, two, four, and seven months after initial readings of length and planeness do not give very much information regarding the progress of the changes taking place. Where the greatest changes occur in either length or planeness they appear to progressively increase with time. In many cases where these changes have been smallest over the entire time interval they seem to occur in the intervals immediately following the first measurement, the gages thereafter remaining constant.

17 The Preparation of Magnesia by a New Method

About 100 lb. of electrically fused magnesia have been prepared by the method described in last month's bulletin. Thus far it has not been possible to produce fused magnesium oxide containing less than 0.02% SiO_2. This is not, however, a sufficient amount to prevent its use in the melting of electrolytic iron and iron carbon alloys. An iron carbon alloy (1.5% carbon) absorbed only 0.03 Si from a crucible made from MgO which contained 0.3% SiO_2. Crucibles of electrically fused MgO undergo so little shrinkage that it is possible to melt in the tamped and dried crucible without the preliminary calcination to 1500 or 1600°C which was necessary with the old type of crucible made from less high calcined material. Samples of "Zircon" have been obtained for test in comparison with "Zirkite". These are the two zirconium refractories at present obtainable commercially and in standard refractory shapes. Preliminary tests showed that "refined Zircon" has a melting point considerably below that of "Zirkite Cement" and also indicates that refined zircon reacts with carbon and high temperatures more readily than with Zirkite.

18 Recent Metallurgical Publications

A new scientific paper on "Relation of Grain Size to the Brinell Hardness of Annealed Carbon Steel" by Rawdon and Jimeno has appeared in printed form and is ready for distribution. Chemical and Metallurgical Engineering for October 20 contains the second installment of results of the investigation on the Metallography of Arc-Fused Steel conducted in the Bureau's laboratory.

19 Electric Resistance of the Human Body

During the past few months some measurements have been made of the electric resistance of the human body. In this work the measurements were made for the first time in such a way as not to include the resistance through the skin where current entered and left the body. By eliminating the large and uncertain resistances through the skin, results were gotten which are more consistent than any previously obtained. These show that the resistance of the same part of the body of different individuals may differ by a ratio of 3 to 2 or even more, the resistance of a person changes from day to day and often by small amounts in an hour, also the resistance depends to some extent upon the position of the body and the extent to which the

muscles are relaxed.

There is reason to think that a part of the difference found between different persons and some of the changes observed in the same persons depend upon pathologic conditions. Such measurements may, therefore, be of interest to the pathologist.

A knowledge of the resistance of different parts if the body exclusive of the skin may also be of interest to those concerned with life hazards from high voltage circuits, since when accidental contact is made to such circuits the skin is burned at the point of contact and therefore largely loses its protecting property.

20 Airplane Radio Communication

Experiments on the use of radio apparatus as an aid in aerial navigation are described in a publication recently completed. The experiments were conducted jointly by the Post Office Department and the Bureau of Standards and have resulted in the following conclusions:

Radio signalling is a practical aid to navigation provided certain precautions are taken, such as making the radio apparatus sufficiently rigid to stand severe vibration and the use of a special type of antenna located in the fuselage of the machine as far as possible from the engine and the wires of the ignition system. Metal sheaths must be provided to protect the radio receiving apparatus from the ignition system although the disturbances from this cause can be reduced by the use of a compensating coil in the receiving apparatus.

The use of a coil type of antenna or radio compass makes it possible not only to carry on communication but also to guide the airplane and determine its position by radio methods. By the use of special transmitting apparatus located on the landing field, the airplane is able to determine its position with respect to the field and to descend safely in darkness or fog. Two methods have been found practicable for such signalling apparatus; the use of alternating current of relative low frequency in a large coil on the landing field, and the use of radio signals transmitted from a special type of antenna on the landing field. While much has already been done, there is need for a great deal more research

and development in order to perfect the use of radio on airplanes. The satisfactory solution of these problems will result in more reliable communications, decrease in the cost of apparatus, and increase in the distance over which communication can be carried out.

Respectfully,

S. W. STRATTON

Director
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